

BIOSYSTEMATICS OF GROUND-NESTING SPECIES OF *PISON* IN
AUSTRALIA (HYMENOPTERA: SPHECIDAE: TRYPOXYLINI)

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Abstract.—Four species of *Pison* are reported nesting in the ground in eastern Australia. Three of these are described as new: *areniferum*, n. sp., *ciliatum*, n. sp., and *barbatum*, n. sp. (all from Queensland). All three nest in dry, sandy soil and have a well-developed psammophore which is used in carrying soil from the nest in flight; all three prey upon spiders of the family Oxyopidae. A fourth species, *auriventre* Turner, also carries soil in this manner, but digs in firm, clay soil and preys upon Lycosidae.

Pison is a large genus of wide distribution, the members of which prey upon spiders and for the most part make nest partitions or entire nests of mud, as in the related genus *Trypoxylon* (Bohart and Menke, 1976). There are only two published records of *Pison* species nesting in the ground. Krombein (1950) reported *nigellum* Krombein nesting in holes in a clay bank along a forest trail on Ponape (Micronesia), but it is uncertain whether these holes were dug by the wasps or were holes that had been abandoned by some other arthropod. *Pison chilense* Spinola evidently does dig a burrow in firm soil near streams, but is reported to moisten the soil with water prior to digging and to make mud partitions between the cells much as twig-nesting *Pison* do (Janvier, 1928).

The present report concerns several species of ground-nesting *Pison* occurring in eastern Australia. One of these (*auriventre* Turner) nests in firm soil near streams and carries soil from the nest and deposits it elsewhere; a weakly developed psammophore evidently assists in this behavior. Three other species (all previously undescribed) nest in dry, sandy substrates and have an unusually well-developed psammophore consisting of stiff hairs on the genae, prosternum, and front legs. Nesting of *Pison* species in sandy soil and without use of water in nest construction or closure is previously unreported. Also, no other species of the genus are reported to possess a psammophore.

The species treated here all belong to the subgenus *Pison*. That none of the sand-inhabiting species is conspecific with any of the species described

by F. Smith or R. E. Turner has been confirmed by study of the types of the those species in the British Museum (Natural History). Types of the species described below have been placed in the Queensland Museum, Brisbane, with paratypes and voucher specimens at the University of Queensland, Brisbane.

Pison areniferum Evans, NEW SPECIES

Type.—♀, QUEENSLAND: Amby, 22–27 November 1979 (H. E. Evans, note no. 2748).

Description of female type.—Length 10 mm; forewing 7.5 mm. Body and legs black, mandible in part dark ferruginous; antenna fuscous, suffused with dull ferruginous on outer surface; tegula translucent, testaceous posteriorly; wings subhyaline, slightly darkened in a broad band along outer margins. Body clothed with silvery pubescence which is especially dense and conspicuous on clypeus, front, gena, pronotum, front femur, mesopleuron, propodeum posteriorly and laterally, and broad apical bands on terga 1–5. Mandible with a series of long, curved, golden setae below; gena with a series of long, curved, somewhat golden setae margining a broad, polished area surrounding the mouthparts ventrally; foretrochanter and femur fringed with long, curved setae below; forecoxa and prosternum also with long setae.

Clypeus with a broad, polished median lobe with a convex apical margin; front, vertex, and gena with contiguous, minute punctures which give the surface a somewhat granulate appearance; distance between eyes at their lower end (across middle of clypeus) $1.8 \times$ minimum interocular distance at vertex; distance between eyes at their greatest emargination $2.35 \times$ minimum interocular distance at vertex; posterior ocelli separated from eyes by a distance very slightly exceeding their own diameters. First 4 antennal segments in a ratio of 5:2:4:4, segment 3 $0.43 \times$ as long as minimum interocular distance at vertex. Mesoscutum and scutellum shining, with small punctures which for the most part are separated by slightly more than their own diameters; dorsum of propodeum with minute, close punctures, faintly striatopunctate; midline with a linear impression which is deepened as it passes down the declivity. Terga of gaster densely micropunctate, weakly shining, broadly depressed along posterior margins, where the silvery bands occur; venter much more shining and sparsely punctate. Forewing with petiole of 2nd submarginal cell subequal in length to height of that cell; 1st recurrent vein interstitial with 1st transverse cubital vein; 2nd recurrent interstitial with 2nd transverse cubital.

Remarks.—This species is known only from the type. It runs to *punctulatum* Kohl in the key of Turner (1916), but that is a more coarsely punctate species without a psammophore and with constrictions between segments of the gaster.

Nesting behavior.—The female described above was found nesting in a flat, sparsely vegetated sandy area among numerous nests of *Bembix tuberculiventris* Turner. A second female nested 80 cm away, both females carrying sand from the burrow in their mouthparts and front legs and flying with it about 1 m downwind, dropping it from a height of 30–40 cm. Digging continued for several hours in the morning, intervals between flights varying from 30 seconds to several minutes. On the following day one nest had been closed at the entrance and the other was open and apparently abandoned. On the third day still another female (or perhaps the one that had abandoned her nest) was seen digging nearby in the same manner. On this date the nest that had been closed was excavated. The burrow was found to descend at about a 45° angle; it was 14 cm long and reached a cell at a depth of 9 cm. It was open all the way to the cell aside from a closure of sand at the entrance about 1 cm thick. The cell contained a single paralyzed spider but no egg, and was evidently still being provisioned. A second cell was found 1.5 cm away, at a depth of 10 cm. It had been closed off with sand and contained five spiders which had been partially consumed by a fly maggot. Four spiders were saved for identification and all found to be Oxyopidae: *Oxyopes mundulus* Koch (3) and *O. punctatus* Koch (1).

Pison ciliatum Evans, NEW SPECIES

Type.—♀, QUEENSLAND: Amby, 22–27 November 1979 (H. E. Evans, note no. 2754).

Description of female type.—Length 7 mm; forewing 5.6 mm. Head black, mandible and anterior margin of clypeus castaneous; antenna fuscous on upper surface, castaneous beneath; thorax and propodeum black; tegula testaceous; coxae black, trochanters and forefemur partially infuscated, legs otherwise rufous; gaster black except apical and lateral margins of basal 5 segments broadly brownish; wings subhyaline. Body with extensive, rather coarse, pale pubescence, on clypeus and sides and venter of thorax silvery, on most of head and dorsum of thorax and propodeum golden; gaster with golden pubescence which is much more coarse and dense on the apical tergal bands. Mandible with numerous long, curved, golden setae beneath; margin of labrum with several stiff setae which protrude from beneath margin of clypeus; gena with a psammophore of long setae margining a broad, polished area surrounding the ventral mouthparts; foretrochanter and femur with numerous curved setae on lower margin; forecoxa and prosternum also with prominent setae.

Clypeus similar to that of *areniferum*: front, vertex, and temples with subcontiguous, minute, shallow punctures; distance between eyes at lower end (across middle of clypeus) 1.8× minimum interocular distance at vertex; distance between eyes at their greatest emargination 2.4× minimum interocular distance at vertex; posterior ocelli separated from eyes by a distance

subequal to their own diameters. First 4 antennal segments in a ratio of 9:4:7:7, segment 3 $0.37\times$ as long as minimum interocular distance at vertex. Microsculpture of thorax similar to that of head; dorsum of propodeum with a slight tendency to be obliquely striatopunctate, median carina strong, continuing down declivity as a deep sulcus. Gaster also micropunctate, punctures on dorsum subcontiguous, those on venter separated by mostly somewhat more than their own diameters. Venation as described for *areniferum*.

Paratypes.—3 ♀, same data as type except one of them dated 25–26 October 1979 and all without note numbers.

Remarks.—The paratypes resemble the type closely in size and in all major details. In two of them the petiole of the second submarginal cell is considerably longer than the height of the cell. This species runs to couplets 42–47 of Turner's key (1916), but there is no close resemblance to any of the species separated there. In size and color it is perhaps closest to *inconspicuum* Turner, but that species (described from a male from Western Australia) differs greatly from *ciliatum* in structural features and is not likely to be the male of that species. The development of the psammophore and associated structures is shared only with the preceding and the following species.

Nesting behavior.—This species was found nesting in the same area as *areniferum*, also among *Bembix* nests, but on a small hillock some 50 m away. The substrate was similar, consisting of fine-grained sand of reddish color. Several females were seen, but only one was found nesting. She was first seen flying slowly and hovering 5–10 cm high, moving in a circuitous pattern while holding a small spider in her mandibles. She plunged into an open hole in the sand at 1115 hours and emerged two minutes later, when she was taken. The burrow was found to be oblique for the first 3 cm, below that vertical, reaching a depth of 16 cm, where there was a small cell containing five spiders. The cell was evidently not fully provisioned, as there was no egg. All spiders were *Oxyopes mundulus* (Koch), one of the species being employed by *Pison areniferum* in the same locality. Although females of *P. ciliatum* were not observed digging, the presence of a well-developed psammophore suggests that sand is carried in the same manner as in *areniferum*.

Pison barbatum EVANS, NEW SPECIES

Type.—♀, QUEENSLAND: Port Douglas, 25 April 1980 (H. E. and M. A. Evans, note no. 2895).

Description of female type.—Length 7.5 mm; forewing 5 mm. Head black, mandible in part deep ferruginous; antenna black; thorax and propodeum black; tegula in part translucent, testaceous; legs black; gaster black except terga 1–5 narrowly brownish along apical margins; wings subhyaline, very slightly darker along apical margins. Body extensively clothed with silvery

pubescence which is especially dense and conspicuous on clypeus, face, gena, pronotum, mesopleuron, posterior angles of propodeum (where it is suberect), and narrow apical bands on terga 1-5. Distribution of setae of psammophore and adjacent body parts exactly as described for *ciliatum*.

Clypeus of the same form as in *ciliatum* and *areniferum*; front, vertex, mesoscutum, and scutellum with well-defined but small, subcontiguous punctures, weakly shining; distance between eyes at lower ends (across middle of clypeus) $2.4\times$ minimum interocular distance at vertex; distance between eyes at the greatest emargination $3.15\times$ minimum interocular distance at vertex; posterior ocelli separated from eyes by about $\frac{1}{2}$ their own diameters. First 4 antennal segments in a ratio of 9:4:8:8, segment 3 $0.5\times$ as long as minimum interocular distance at vertex. Dorsum of propodeum obliquely striatopunctate, with a delicate median carina which becomes a deep sulcus on declivity. Gaster micropunctate, punctures of terga separated by about or less than their own diameters, those on venter by $1-2\times$ their own diameters, though more crowded laterally. Forewing with petiole of 2nd submarginal cell slightly longer than height of cell; 1st recurrent vein interstitial with 1st transverse cubital, 2nd recurrent meeting cubitus slightly before junction of 2nd transverse cubital.

Paratype.—1 ♀, same data as for type except without note number.

Remarks.—The paratype is closely similar to the type in all details. This species differs from *ciliatum* not only in the color of the legs and pubescence, but also in having the eyes more strongly convergent at the vertex and the posterior ocelli closer to the eye margins.

The type-specimen was taken on flat, sandy soil adjacent to a mangrove swamp. It was on the sand, apparently struggling with a small spider, which it presently grasped with the mandibles and began to fly away with. At this point it was taken, and the spider later found to be a male of the genus *Oxyopes* (Oxyopidae). The presence of a psammophore in this species suggests that the nest was probably in sandy soil not far away.

Pison auriventre Turner

This species was described by Turner (1908) from females from Brisbane, Queensland, and from Victoria. I studied the type in the British Museum (Natural History) and found my specimens to be conspecific. This species has a weakly developed psammophore; the mandibles have a series of short, curved bristles beneath and the labrum has several stiff bristles; the ventral surface of the head is moderately polished adjacent to the mouthparts, but this area is bordered by only a few short setae on the lower gena; the prosternum has a tuft of setae and the foretrochanter several strong setae, but the forefemur lacks prominent setae. It is probably significant that this species nests in firm clay soil, such that pellets from the nest remain more or less intact without assistance from long genal and femoral setae.

Nesting behavior.—Two female *auriventre* were seen nesting 35 cm apart on the crest of a clay bank bordering Blunder Creek, in a *Melaleuca-Eucalyptus* woodland in the southern part of the city of Brisbane, on 8 November 1979. Both were digging a vertical hole by backing out with small lumps of soil in their mandibles and flying off about a meter and dropping the soil from a height of about half a meter. Thus no soil accumulated at the entrances, which were about 40 cm away from an active nest of *Cerceris antipodes* Smith. Three days later one of the wasps was seen bringing in small spiders, carrying them in her mandibles in flight, landing near the entrance, and walking directly into the open hole with the prey. This nest was excavated the same day and found to have a vertical burrow 3 mm in diameter and 4.5 cm long, terminating in an oblique cell measuring 11 mm long and 5 mm in diameter. This cell contained four paralyzed spiders and no egg, so was apparently still being provisioned. A second cell 1 cm away had been fully provisioned and closed off. It contained nine spiders, the one uppermost in the cell bearing the wasp's egg dorsally, obliquely at the extreme base of the abdomen. All spiders were very small and all were Lycosidae: *Trochosa expolita* Koch (12) and *Lycosa laeta* Koch (1).

DISCUSSION

There can be little question of the close relationship of the three species *areniferum*, *ciliatum*, and *barbatum*. All inhabit areas of bare, fine-grained sand, and two of them are known to make short burrows terminating in a cell in which the spiders are placed. One species, *areniferum*, has been found to make a second cell, and it is probable that most nests are multicellular. There is no evidence that these wasps use water at any stage in nest construction, and the presence of an unusually well-developed psammophore in all three suggests that sand is carried in the manner described for *areniferum*. The apparent exclusive use of spiders of the family Oxyopidae is further evidence of the close relationship of these species.

In contrast, *auriventre* has a poorly-developed psammophore, doubtless correlated with the firm clay soil in which this species nests. However, soil is still carried from the nest in flight and dropped some distance away, and there is no present evidence of the use of moistened soil at any point in the nesting process. This stands in contrast to most other species of *Pison*, which have no evidence whatever of a psammophore or of a smooth area adjacent to the ventral mouthparts and which use mud in nest construction. In its use of Lycosidae rather than Oxyopidae as prey, *auriventre* may be said to be more like the mud-using species, several of which are known to employ Lycosidae. On the other hand, this may simply reflect differences in habitat rather than a real difference in hunting behavior.

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